

Turnford, Kentish Town, and Tottenham Court Road; and thus only six or eight more borings would be necessary. With the improved methods of working by the diamond rock-drill, these borings could probably be carried to the depth of 1000 feet at the cost of a few thousands of pounds, and this would be a very moderate sum to pay for settling such a highly important question. It is of course possible that only two or three of these borings would be required, and the order in which they should be executed must be in a great measure determined by the results which were obtained by those first put down. Probably it would be well to commence with the sites suggested by Prof. Prestwich and Mr. Godwin-Austen respectively, namely, Croydon or Sydenham, and a point near the North Downs.

The only chance of this line of borings missing the coal-bearing strata would result from the circumstance that the coal-troughs are not continuous, but are, in all probability, like those of Belgium and Northern France, separated by pre-Cretaceous upheaval and denudation, along lines crossing the great axis, into separate long and narrow basins. It is therefore just possible that a boring might reach a point lying between two such basins. It would follow from this that while the Coal-measures, if they exist, would in all probability be found by such a systematic search as we advocate, yet the failure to discover them would not absolutely demonstrate their absence in the whole of the Metropolitan district.

Since it is the people of London who would mainly benefit by the discovery of coal under their city, it is by them that the effort to raise the comparatively moderate sum of money required for such a systematic search as we have advocated must be made. When the magnitude of the interests at stake is remembered, it is surely not too much to hope that, so soon as the people of this city fully realise the importance of the evidence brought forward by geologists, they will be prepared to make the necessary effort to secure the decision of the question in the only way that is practicable, namely, by actual experiment.

Some of those who have recently engaged in this discussion have taken it for granted that the great smoke-pall that too often rests over this city would necessarily be increased by the discovery of coal beneath London. They have therefore stigmatised geologists as "Philistines," resolutely bent on destroying all the little "sweetness and light" left to the unfortunate inhabitants of London. But it is by no means certain that any such effects would follow from the discovery of coal in the metropolitan area. It must be admitted that the beautiful landscapes of our home counties would not be improved if coal-tips, engine-houses, and winding-gear were to rise in all directions about them, but the reduction of coal and gas bills to one-half or one-third of their present amount would, by most London householders, be regarded as a sufficient compensation for such disadvantages. Judging from the character of the coals found in the Bristol and Somerset and the Belgian coalfields, it is probable that while gas- and caking-coals would not be wanting, a great part of the coal under London would prove to be anthracite and hard coals. Every one who has visited the Smoke Abatement Exhibition must be convinced that there is a great future for such varieties

of coal. The people of London who are reluctant to alter the construction of their grates so as to adapt them to the use of such coals, at their present prices, might find it well worth their while to do so if those prices were reduced to one-half or one-third of what they are at present.

In this way the discovery of coal under London might lead the way to that general reform in our domestic hearths, which we all desire, but which we find it so difficult to realise; and thus, perhaps, the discovery of coal at a moderate depth beneath us, paradoxical as the suggestion may appear, may lead to the purification of our London atmosphere.

JOHN W. JUDD

THE ENCYCLOPÆDIA BRITANNICA

The Encyclopædia Britannica. Ninth Edition. Vol. XIII. Inf.—Kan. (Edinburgh: A. and C. Black, 1881.)

IT is impossible to do justice in detail to all the leading scientific articles in this volume; we can only express our satisfaction of the admirable manner in which the publication keeps to the level of its first promise. We have only space to glance at one or two articles, regretting that those on "Instinct," by Mr. Romanes; "Insectivorous Plants," by Mr. P. Geddes; "Iron," by Dr. Alder Wright; "Kangaroo," by Prof. Flower, and others of equally high mark, can only be mentioned.

In Mathematics the *pièce de résistance* is a very carefully digested article upon the *Infinitesimal Calculus*, by Mr. B. Williamson, F.R.S., who has already won his spurs in this field by his two treatises on the Differential and Integral Calculus. In a former notice we expressed ourselves somewhat hesitatingly upon the utility of elaborate articles upon branches of mathematics in a work of this kind, but the "Calculus," we think, lends itself more readily to such treatment than almost any other branch. Certainly the subject, in the hands of Mr. Williamson, is handled in such a way that the student, so far as the text is concerned, will be independent of any of the usual textbooks, and will only require to consult them for exercises to try his hand upon, to test his acquaintance with the principles herein so clearly unfolded and aptly illustrated. The advanced mathematician also will find not only sufficient matter for his purpose, but, what is more serviceable to him, a ready means of reference to the original sources of information. In this respect we cannot speak too highly of the care bestowed on all parts of the two divisions into which the Infinitesimal Calculus bifurcates. The narrative of the contributions of Legendre, Gauss, Abel, and Jacobi to elliptic functions, in the concluding portion of the paper, is an admirably lucid exposition of the relative positions of these great analysts in this department. Mr. Williamson devotes 120 columns to the practical portion of his article: in these he naturally treads on the lines he has pursued in his previous works. He follows the subject of *Envelopes* with a sketch of *Symbolic Methods*, first started by Arbogast, who was succeeded by François, Servois, and in more recent times by Hargreave, Boole, and Crofton. He gives useful reference here also to Hankel and Grassmann, who have treated symbolic methods in a comprehensive manner. Another novel section in this connection

is one on Jacobians, in which the elementary properties of these functions are put before the reader.

In Part II., under Frullani's theorem, reference is made to the recent extensions by Messrs. Elliott and Leudesdorf, and the demonstration by M. Zolotareff, that the remainder in Lagrange's theorem is expressible as a definite integral is given. Our Author was not aware that Mr. Emory McClintock had applied the same mode of demonstration to the similar case of Laplace's theorem, as the number of the *American Journal of Mathematics* (vol. iv., No. 1) has reached this country subsequently to the publication of his article. Due importance is assigned to Definite Integrals and to the hyperbolic functions which now play an important part in investigations.

The last 79 articles are devoted to the subject of elliptic functions, upon which we have written above. The whole of this discussion convinces one how well fitted the writer is to bring out a separate treatise on this branch, and we hope that a rumour which has reached us will soon become an actual fact. We may note the appearance within a very recent date of a new edition of Abel's works. Passing now from the *practical* treatment to the *historical*, which rightly is put in the forefront of the communication, we need not dwell in any detail upon the early history of the subject. That has reached its position of equilibrium, and no stormy winds of controversy are likely to disturb its calm. But we did wonder what position Mr. Williamson would take when he came to discuss the *commercium epistolicum* business. We ourselves had long thought that little could be added to De Morgan's summing-up, still we remembered some strong language which once appeared in our epistolary columns (see vol. v. pp. 62, 81, 121). We need hardly say that Mr. Williamson appears to have gone over all the sources of information which we had ourselves recently examined, and he seems to us to have come to the right solution. We append his summing-up:—

"It is the less necessary now-a-days to enter into the merits of this great quarrel, inasmuch as it has long been agreed upon, by all mathematicians who have examined into the controversy; that Newton and Leibnitz are both justly entitled to be recognised as independent discoverers of the principles of the calculus, and that, while Newton was certainly master of the method of fluxions before Leibnitz discovered his method, yet Leibnitz had several years priority of publication."

A VERY effective article is the one on insects by Mr. R. McLachlan, F.R.S. In it we find condensed into a few pages a very correct and instructive history of this immense class of that subdivision of the animal kingdom now known as the Arthropods. As in most of the classes of the animal kingdom, the limits of the class Insecta are not very sharply defined. In general every one thinks that it is an easy task to define an insect, but to do so in the way that we can define a mammal is not possible with our present knowledge; still a fairly satisfactory diagnosis is here given to us, and the certain small aberrant groups are not altogether overlooked. The insects not only form the largest class of the arthropodous sub-kingdom, but, according to the author, possibly outnumber all the other members of the animal kingdom besides. It seems certain that at the present time there are about 80,000 pre-

sumably distinct species of beetles described, and it seems safe to assume that the number of known species of other orders is greater, thus giving a total of about 200,000. But as yet we are only on the threshold of our knowledge of the forms that actually exist in Nature—many enormous groups of living forms being still only very partially studied—so that we may pretty confidently anticipate that some day, not very far distant, the number of known forms will not fall far short, the author writes, of 1,000,000, but we would feel inclined to write instead 500,000. As to the antiquity of the group, indications of it appear in the Devonian series, and become more marked and numerous in the Carboniferous. With few exceptions these are those of insects belonging to orders in which the metamorphoses are incomplete, and there seems no evidence that any anthrophilous insects, such as bees or butterflies, were then in existence. As one ascends the geological scale, insect life gradually develops itself, not becoming however at all abundant until Tertiary times. As to their geographical distribution, they would seem to be everywhere on the earth's surface, the more attractive forms are more often denizens of the tropics, but showy butterflies were found during the late Arctic Expedition almost up to 83° N. lat. They occur on land, in fresh-water, in hot springs, in brine, in the deep recesses of vast caverns, on the surface of the ocean, and we may add, are at home under the flow and ebb of its waters all around our own shores. The subjects of the duration of their life, their uses to man, the injuries they directly and indirectly inflict on him, their parasitism, their anatomical structure, the wondrous story of their change of form, these are all ably though briefly handled. The systematic portion of the article, though of necessity condensed into the smallest possible compass, is especially interesting. The sequence of the orders is:—

Metamorphosis complete	{	Hymenoptera
		Coleoptera
		Diptera
		Lepidoptera
		Neuroptera
Metamorphosis incomplete	{	Orthoptera
		Hemiptera
		Collembola
No metamorphosis	{	Thysanura.

The stumbling-block of all systematists has been the Linnean order Neuroptera. The author manages it after the method of Erichson, placing those neuropterous forms with an incomplete metamorphosis as the sub-order Orthoptera. He tucks in the Diptera between the Coleoptera and Lepidoptera, a position we doubt very much that they will consent to occupy, though on the author's views as to the absolute value of metamorphosis in classification, this position might stand. The Mallophaga are without hesitation placed as degraded Pseudo-neuroptera, and the Anopleura as equally degraded Hemiptera, despite what veterans in entomological science (*i.e.* people too old to take in new ideas) may say. But, says Mr. McLachlan, there is a breaking point to elasticity even in ideas of classification; and so he avails himself of an assertion of Sir J. Lubbock, that the Collembola and Thysanura—sprightly things—are scarcely within (we note not without) the pale of true insects. Still fearing that no one else might write about them, that they might be overlooked by the writers of the articles on Crustacea, Arach-

nida, and Myriopoda—as, to speak the truth, was even more than likely—we have a neat little account of them given here. We have written enough to indicate what a freshly-written and interesting though condensed article this is, though on a well-worn theme, and we must be pardoned for so briefly touching on the burning question of classification.

OUR BOOK SHELF

The Year-Book of Pharmacy, and Transactions of the Pharmaceutical Conference. 8vo. Pp. 560. (London: Churchill, 1881.)

THIS year-book is divided into several parts—an introduction, which gives a short account of all that has been done in the year, a section in chemistry, another on materia medica and pharmacy, one on notes and formulæ, another on bibliography, and lastly, the transactions of the British Pharmaceutical Conference at York. A number of short abstracts of interesting papers are included in the work. The excitement caused by the recent case of poisoning by aconitine is likely to make the reader turn first to the papers on this alkaloid. Dr. Wright has furnished his researches on the alkaloids of aconite, the chief being aconitine, which is the active principle of the ordinary monkshood, and the pseud-aconitine, which is the still more deadly alkaloid of the *aconitum ferox*. Powerful as those poisons are, one much more powerful has been obtained by Dr. Langgaard from a species of Japanese aconite. Another paper, of much interest from a forensic point of view, is one on ptomaines, or alkaloidal bodies found in human corpses after exhumation. These are actual poisons, formed in the body by putrefaction, and bearing considerable resemblance, both in their chemical reactions and poisonous effects upon animals, to natural vegetable alkaloids. This subject is one of very great importance, as the condemnation of perfectly innocent persons might result from one of these ptomaines being mistaken for a vegetable poison. There are a number of other researches on the active principles of various plants, remedial and poisonous, but all these yield in interest to those on the synthesis of similar bodies, for the great object of medicine is to cure, not by chance, but with certainty, and towards this object all branches of medical science are as present tending. It was formerly the reproach of medicine that doctors poured drugs of which they knew little into bodies of which they knew less; but now, thanks to experiments made upon animals, instead of upon patients, they now know a good deal both of the bodies they have to treat and the remedies which they are using. Hitherto, however, they have been compelled to use many powerful substances derived from plants, but varying more or less in their constitutional actions. Numbers of these substances have now been examined, and it is probable that before long we shall make them artificially. Prof. Ladenburg has now obtained atropine and hyoscyamine from the nightshade, thorn-apple, henbane, and Duboisia, and has lately got a third principle, hyoscine, from henbane. By decomposing atropine he has obtained tropic acid and tropine, and by recombining these products he again formed atropine. In conjunction with L. Rügheimer, he has now succeeded in making tropic acid synthetically from aceto-phenone, and we now await the synthesis of tropine in order to complete the method of preparing atropine artificially. M. Grimaux has succeeded in converting morphia into codia, another of the alkaloids of opium; and such researches as these, taken in connection with the rapid advance of our knowledge regarding the physiological action of these substances, leads us to hope that the day may not be so far distant when a medical man, wishing to produce a certain effect upon his patient, will no longer have to

search haphazard amongst various plants, but will direct the chemist to make the particular body which he requires. We may mention still another paper, less interesting to medical men, but more so to the public at large. Prof. Baeyer succeeded, some years ago, in preparing indigo artificially, but the process was so expensive that it was not likely to be of much practical importance. He has now, however, succeeded in effecting the synthesis in another way, by which he can not only produce the indigo much more cheaply, but can produce it within the fibre of the material to be dyed. The artificial production of alizarin has already wrought a great change in the commercial relations of the South of France, and if indigo be produced synthetically at a lower price than it can be grown, similar alterations may result in some parts of our Indian Empire.

The New Ceylon. Being a sketch of British North Borneo, or Sabah. From official and other sources of information. Written and compiled by Joseph Hatton. (London: Chapman and Hall, 1881.)

IT was hardly to be expected that the new British possession in North Borneo, to which the Queen has recently granted a charter, should long remain without its chronicler. Information at first hand respecting the country is very scarce, but, in the absence of this, Mr. Joseph Hatton in his little volume furnishes us with all that we can expect for the present. The materials placed at his disposal consisted of certain private letters and reports from explorers and the correspondence of the directors of the North Borneo Company. In addition to these he has made use of all that has already been written on Borneo, and the result—"a pioneer volume," he modestly calls it—is such as might have been expected from Mr. Hatton's well-known literary skill. The value of the new colony to science is rather potential than actual. In Labuan and Sarawak we have only touched the fringes of this vast island; we know but little of its mineral wealth and other natural resources; its geography, geology, fauna, and flora, have never been thoroughly studied. Even Mr. Carl Bock, in the journey described in his recent volume, only crossed a small corner of Borneo. With a settled government, under the British flag, we may expect a great increase in our knowledge of one of the largest and most interesting islands in the world. Mr. Hatton could, had he chosen, have added an interesting account of the early trade of the East India Company to Bandjermassin and other ports in Borneo from the Calendar of State Papers, Colonial Series, edited by Mr. Sainsbury.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Earth-Currents

THE Astronomer Royal desires me to mention, in regard to Mr. W. H. Preece's communication (p. 289) describing an unusually sudden appearance of earth-currents between 10h. and 11h. p.m. on January 19, that our magnetic and earth-current registers both show, throughout the night of January 19, more or less of unusual disturbance, never however very considerable. The greatest deviation occurred in a sudden wave at 10h. 15m., as Mr. Preece describes. From 10h. 50m. until midnight there was general quiet, and the disturbance afterwards was not great.

WILLIAM ELLIS

Royal Observatory, Greenwich, S.E., January 28